



New occurrences of Salicaceae from the Atlantic Forest and Caatinga (Brazil)

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Abstract

Based on new records, we expand the geographical distributions of 6 species of Salicaceae: *Banara nitida* Spruce ex Benth., *Casearia marquettei* Nepom. & M. Alves, *C. souzae* R. Marquete & Mansano, *Macrothumia kuhlmannii* (Sleumer) Alford, *Xylosma glaberrima* Sleumer, and *X. pseudosalzmanii* Sleumer, from the Atlantic Forest and Caatinga. Illustrations of the diagnostic characters of the species, maps of geographic distribution, and a key for identification of the genera of Salicaceae occurring in the Atlantic Forest and Caatinga are provided.

Key words

Banara; *Casearia*; geographical distribution; Flacourtiaceae; *Macrothumia*; *Xylosma*.

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Introduction

The Salicaceae (Malpighiales) are pantropical, with 3 subfamilies including 1010 species and 55 genera (APG 2016, Stevens 2001). Among them, *Casearia* Jacq. is the most representative, and *Macrothumia* Alford is endemic to Brazil (Alford 2006, Sleumer 1980). In Brazil, the family has about 100 species and the most representative genera are *Banara* Aubl. (9 spp.), *Casearia* (50 spp.), and *Xylosma* G. Forst. (10 spp.) (BFG 2015, Marquete and Mansano 2016). Species often occur in humid environments in Amazonia (65 spp.) and the Atlantic Forest (48 spp.), where the greatest diversity in the family is recorded (BFG 2015). However, some species of Salicaceae can also grow in drier areas as found in the Caatinga and Cerrado.

Banara has a Neotropical distribution with 30 species and a center of diversity in the Amazon and Caribbean

(Sleumer 1980). In Brazil, is more diverse in the Amazon with 5 species and Atlantic Forest with 6 species (BFG 2015). Only 2 species are recorded from the Cerrado, 1 from the Pantanal, and none from the Caatinga (BFG 2015). *Casearia* is a pantropical genus with 181 species and a center of diversity in the tropics and subtropics of the American continent (Marquete and Mansano 2016, Nepomuceno and Alves 2017, Sleumer 1980). In Brazil, the center of diversity is in the Amazon, with 30 species, and in the Atlantic Forest, with 27 species (BFG 2015, Marquete and Mansano 2016, Sleumer 1980). It is also diverse on drier areas such as the Caatinga (9 spp.) and the Cerrado (22 spp.) (BFG 2015, Marquete and Mansano 2016).

Macrothumia is a monospecific genus with a distribution restricted to the Brazilian Atlantic Forest (Alford 2006, BFG 2015). It was originally named as *Neosprucea*

kuhlmannii Sleumer but transferred to the genus *Macrothumia* (Alford 2006). *Xylosma* is a pantropical genus of 95 species, with Central and South America being its center of diversity (Sleumer 1980). In Brazil, 6 species are recorded from the Atlantic Forest, 5 from the Cerrado, 4 from the Amazon, and only 2 from the Caatinga (BFG 2015).

The Atlantic Forest is the second-largest block of Neotropical vegetation and originally extended along the entire Atlantic coast of Brazil to parts of Paraguay and Argentina (Galindo-Leal and Câmara 2003). The Caatinga is endemic to Brazil, occurring from the states of Ceará and Piauí to northern Minas Gerais (Prado 2003).

Casearia marquettei Nepom. & M. Alves, *C. souzae* R. Marquete & Mansano, and *Macrothumia kuhlmannii* were described in recent years, all with narrow distributions, as was also the case for *Banara nitida* Spruce ex Benth., *Xylosma glaberrima* Sleumer, and *X. pseudosalzmanii* Sleumer, which were described some decades ago. Based on new records, we extend the geographic distribution of these species to areas belonging to the Atlantic Forest and Caatinga.

Methods

The new occurrences of the species were found during field trips carried out in the states of Ceará, Pernambuco, and Rio Grande do Norte, in addition to our study of vouchers deposited at ALCB, CEPEC, HUEFS, MAC, and UFRN herbaria. The herbaria acronyms are based on Thiers (2018). The geographic coordinates of the collected specimens were obtained using a Garmin eTrex Venture HC GPS receiver. If this information was absent at the specimen labels, the SpeciesLink database (<http://www.splink.org.br>) was consulted. Maps were prepared using software QGIS v. 2.18.6.

The morphological terminology follows Harris and Harris (2001)

Results

Key to the genera of Salicaceae from the Atlantic Forest and Caatinga

- 1 Plants with opposite leaves *Abatia*
- 1' Plants with alternate leaves 2
- 2 Plants armed with thorns, lacking stipules .. *Xylosma*
- 2' Plants unarmed or armed with aculei, with stipules 3
- 3 Plants with foliaceous stipules, 4.0–10 × 3.0–8.0 mm 4
- 3' Plants without foliaceous stipules, 2.0–5.0 × 1.0–2.5 mm 5
- 4 Leaves trinerved; inflorescences terminal *Prockia*
- 4' Leaves penninerved; inflorescences axillary ... *Azara*
- 5 Plants with terminal inflorescences; glands at the

- base of the leaf lamina present or absent 6
- 5' Plants with axillary inflorescences; glands at the base of the leaf lamina absent 7
- 6 Leaves with margin slightly glandular-serrulate to entire, glands 2 at the base of the leaf blade, sessile; inflorescences with peduncle 1.0–1.5 cm long *Macrothumia*
- 6' Leaves with margin glandular-serrate, glands absent or 1(–2) at the base of the leaf blade, stipitate; inflorescences with peduncle 3.0–6.0 cm long *Banara*
- 7 Inflorescences in catkins (aments), flowers unsexed *Salix*
- 7' Inflorescences in corymbose cymes, fascicles or umbels, flowers hermaphroditic 8
- 8 Flowers with nectariferous disc (staminodes) *Casearia*
- 8' Flowers lacking nectariferous disc (staminodes) *Laetia*

***Banara nitida* Spruce ex Benth.**, Journal of the Proceedings of the Linnean Society, Botany 5(Suppl. 2): 93. 1861.

Figures 1A, B, 2A

Trees 5.0–8.0 m tall. Branches cylindrical, glabrous, lenticellate. Leaves alternate, leaf blade 5.0–10(–12) × 3.0–5.0 cm, elliptical, chartaceous to coriaceous, glabrous on both surface, base cuneate, apex acute, margin glandular-serreate, gland 1 at the base of the leaf blade, stipitate, patent, glabrous, black. Inflorescences 1(–2), racemiform, terminal, peduncle 2.0–4.0 cm long, cylindrical, glabrous. Flowers with pedicel 5.0–10 mm long, cylindrical, glabrous; calyx 3(–4)–merous, sepals 4.0–6.0 × 3.0–4.0 mm, oblongs, tomentose; corolla 3(–4), petals isomerous of sepals. Berries 15 mm in diameter, subglobose, glabrous. Seeds not seen.

Banara nitida was previously believed to be restricted to the Amazon phytogeographical domain, occurring in lowland forests in Brazil and montane forests in Colombia, Ecuador, Peru, and Venezuela (Sleumer 1980). We expand the geographic distribution to the Caatinga domain (Fig. 2A). It was collected in the semi-arid region of the state of Ceará in an area above 800 m with vegetation of semideciduous seasonal forest in crystalline soils. It is morphologically similar to *Banara argura* Briq., but can be distinguished by having glabrous leaves (vs pilose leaves) and glabrous inflorescence peduncles and flower pedicels (vs tomentose peduncles and pedicels). According to Gentry (1993), it is possible to identify plants that belong to the genus *Banara* using vegetative characters. This new record reinforces the connection between the Amazon and Atlantic Forest along the coast of the state of Ceará, through the Brejos de Altitude (Maciel et al. 2017).

Examined material. Brazil, Ceará: Pacatuba, Serra da Aratanha (–03.98417, –038.6203), 12.VII.2017, ste., F.A.A. *Nepomuceno* 329 (HUVA).

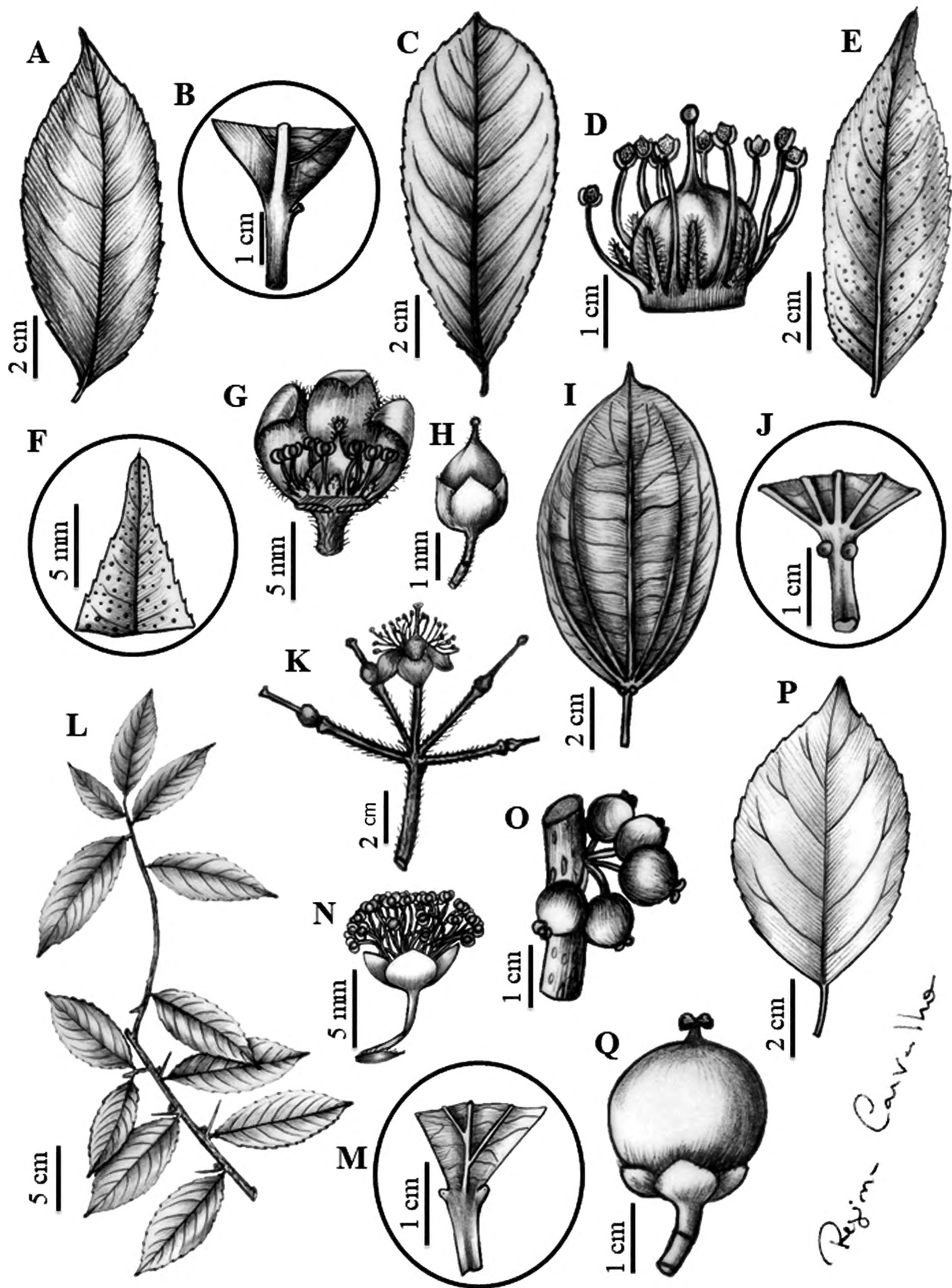


Figure 1. Diagnostic characters of the new records in Salicaceae for the Brazilian Northeast. **A, B.** *Banara nitida*: (**A**) leaf blade; (**B**) detail of base of leaf blade with gland; from F.A.A. Nepomuceno 329 (HUVA). **C–D.** *Casearia marquetei*: (**C**) leaf blade; (**D**) ovary, stamens and lobes of the nectariferous disc; from F.A.A. Nepomuceno 288 (UFP). **E–H.** *Casearia souzae*: (**E**) leaf blade; (**F**) detail of apex of leaf blade; (**G**) flower; (**H**) capsule; from G. Costa 815 (HUEFS; UFRN). **I–K.** *Macrothumia kuhlmannii*: (**I**) leaf blade; (**J**) detail of base of leaf blade with glands; (**K**) inflorescences; from M.T. Monteiro 21884 (HST, HUEFS). **L–O.** *Xylosma glaberrima*: (**L**) branch; (**M**) detail of base of leaf blade with glands; (**N**) male flower; (**O**) berries; L–N from J. Jardim et al. 6609 and O from J. Jardim et al. 6641 (UFRN). **P–Q.** *Xylosma pseudosalzmannii*: (**P**) leaf blade; (**Q**) berry; from M.L. Guedes 5277 (ALCB; CEPEC).

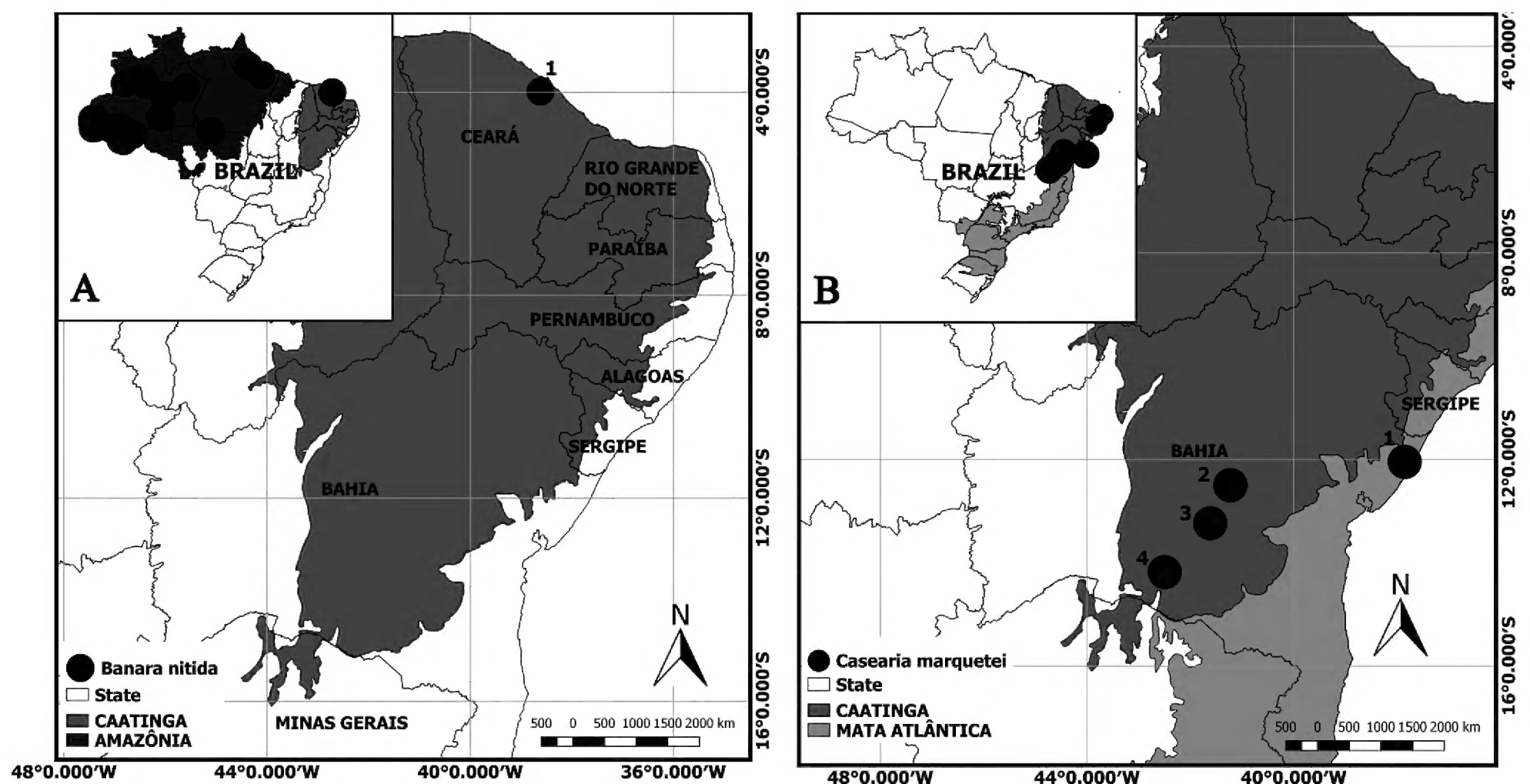


Figure 2. Geographical distribution of (A) *Banara nitida* and (B) *Casearia marqueti*.

Additional examined material. Brazil, Amazonas: Uarini, left bank of the Mamiruará river (−02.99000, −065.1082), 17.XII.1993, fl., fr., *N.A. Rosa 5662* (HUEFS).

Casearia marqueti **Nepom. & M. Alves**, Phytotaxa 311(3): 297–300. 2017.

Figures 1C, D, 2B

Trees 4.0–6.0 m tall. Branches cylindrical, pubescent, densely lenticellate. Leaves alternate, leaf blade 6.0–10 (–12) × 2.5–4.0 cm, oblong-elliptical to elliptical, chartaceous to subcoriaceous, glabrous on both surface, base cuneate, apex acuminate, margin glandular-serrulate. Inflorescences 8–12, umbelliform, axillary, multiflorous, peduncle 4.0–6.0 mm long, cylindrical, tomentose to pubescent. Flowers with pedicels 4.0–5.0 mm long, cylindrical, articulated at the middle, tomentose to pubescent; calyx 5-merous, sepals 3.0–4.0 × 1.2–2.0 mm, oblong, glabrous to puberulous. Capsules 2.0–3.0 × 3.0–3.5 mm, ovoid, glabrous. Seeds 2.0 × 1.0 mm, oblong, glabrous, brownish, testa reticulate-foveolate, partially covered by a white aril.

Casearia marqueti is a recently described Brazilian endemic that was believed to be restricted to the states of Paraíba and Pernambuco in Coastal Lowland Forests and Sub-montane Forests locally known as *Brejos de Altitude* (Nepomuceno and Alves 2017). In Bahia, this species occurs in the Atlantic Forest and Caatinga, being a new record for this last domain (Fig. 2B). Our new record from the Caatinga (Bahia, municipality of Caetité) is an area in dry semi-arid region, where the altitude reaches up to 800 m. This species can be recognized by its oblong-elliptical to elliptical leaves, the glabrous inner surface of the sepals, the oblong and densely pilose nectariferous lobes and glabrous stigma (Nepomuceno and Alves 2017).

Examined material. Brazil, Bahia: Abaíra, estrada para Piatã (−013.2497, −041.6636), 14.II.1992, fl., *L.P. Queiroz 2617* (CEPEC); Caetité, Fazenda Baixa Grande (−014.116667, −042.5), 12.I.2010, fl., *L.J. Alves et al. 221* (HUEFS); Esplanada, Jandaíra (−012.035556, −037.703889), 03.III.2012, fl., *F.S. Gomes 1094* (ALCB); Lençóis, Assentamento Rio Bonito (−012.596944, −041.362778), 03.VI.2001, fl., *L.J. Alves 144* (CEPEC). Paraíba: João Pessoa, Mata do Buraquinho (−07.137364, −034.856676), 07.XI.2016, fl., fr., *F.A.A. Nepomuceno 288* (UFP). Pernambuco: Bonito (−08.508472, −035.721722), 10.II.1967, fl., *D. Andrade-Lima 67–4933* (IPA).

Casearia souzae **R. Marquete & Mansano**, Journal of Systematics and Evolution 51(2): 228. 2013.

Figures 1E, H, 3A

Trees 4.0–6.0 m tall. Branches cylindrical, pubescent, sparingly lenticellate. Leaves alternate, leaf blade 5.0–8.0 (–10) × 1.5–3.0 cm, elliptical to slightly oblong, chartaceous, glabrous on both surface, base cuneate to obtuse, apex acute with apicule, margin glandular-serreate. Inflorescences 18–22, fasciculate, axillary, multiflorous, sessile. Flowers with pedicels 3.0–5.0 mm long, cylindrical, articulated at the middle, pubescent; calyx 5-merous, sepals 3.0–4.0 × 2.0–3.5 mm, obovate to oblong, pubescent. Capsules 3.0–5.0 × 3.0–2.0 mm, ovate, glabrous. Seeds not seen.

Casearia souzae is endemic to Brazil and has been described as restricted to the states of Espírito Santo and Rio de Janeiro where it lives in dense forests and on rocky outcrops (Marquete and Mansano 2013). The occurrence of this species in the states of Alagoas, Bahia, Minas Gerais, Paraíba, Pernambuco, and Rio Grande

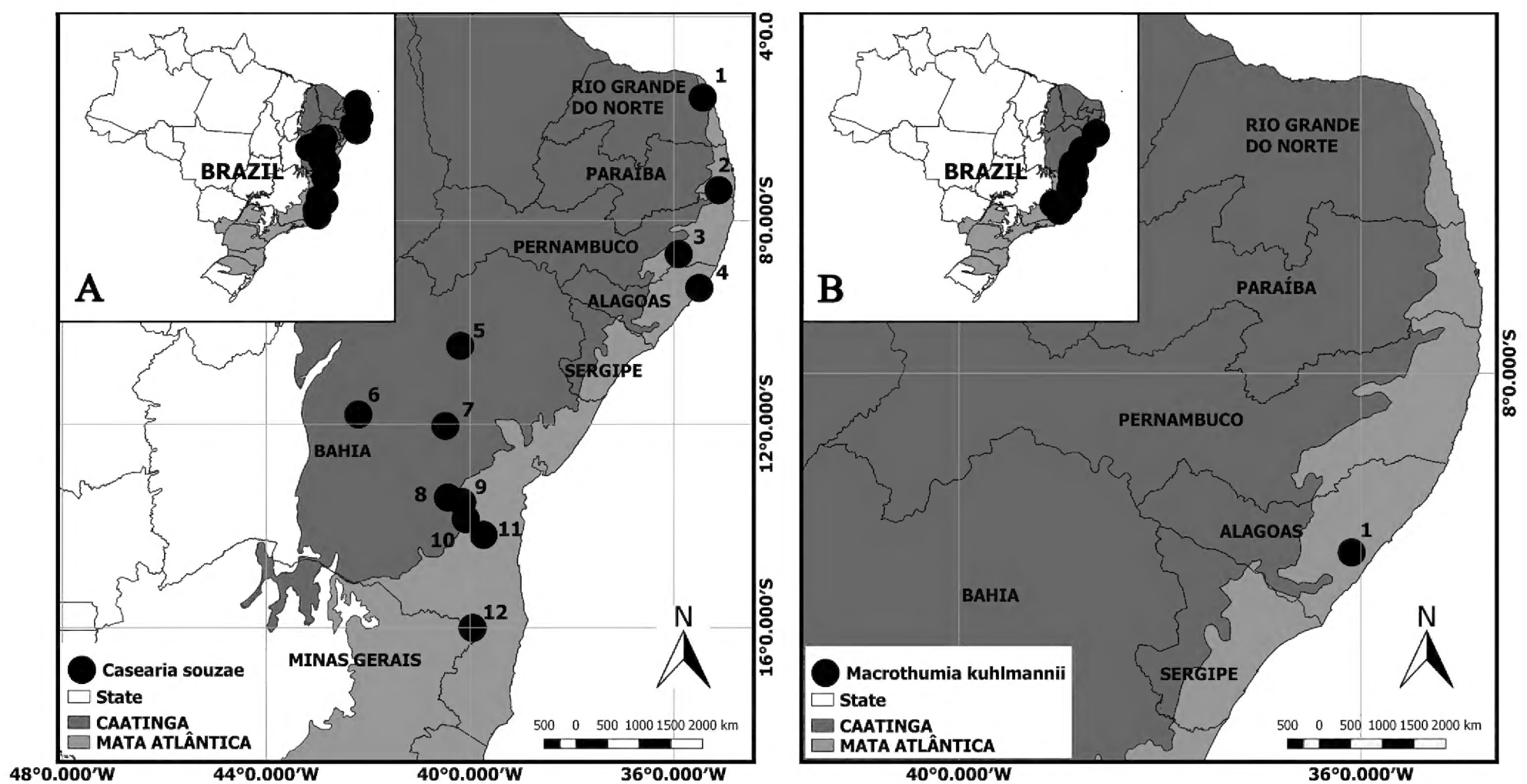


Figure 3. Geographical distribution of (A) *Casearia souzae* and (B) *Macrothumia kuhlmannii*.

do Norte is here confirmed (Fig. 3A). Some of our new records are from the Caatinga and lowland forest north of the São Francisco River. As in other species, the new records reveal that it can grow in different habitats and physiognomies, including areas of secondary vegetation and ecotones. Previously cited specimens were found among exsiccates misidentified under *C. arborea* (Rich.) Urb. and *C. sylvestris* Sw. However, *C. souzae* can be differentiated from *C. arborea* by having glands dispersed over the leaf blade, sepals and ovary (vs glands absent on the leaf blade, sepals, and ovary) and sessile inflorescences (vs pedunculate inflorescences), and from *C. sylvestris* also by having glands on the leaf blade, sepals, and ovary (vs glands lacking on the leaf blade, sepals, and ovary), obovate sepals (vs ovate sepals), and capitate stigma (vs trilobed stigma) (Marquete and Mansano 2016, Nepomuceno and Alves 2017).

Examined material. Brazil, Alagoas: Palmeira dos Índios, Fazenda Fortaleza, Serra das Pias (−09.32383, −035.49581), 21.VI.2008, fl., *R.P. Lyra-Lemos 11154* (MAC). Bahia: Barra do Mendes (−011.808333, −042.191111), 27.I.2001, fl., *M.L. Guedes 8176* (ALCB, CEPEC); Boa Nova, Parque Nacional de Boa Nova (−014.176389, −039.731944), 02.III.2013, fl., *L.Y.S. Aona 2085* (HUEFS); Cruz das Almas, Mata da Cazuzinha (−012.033333, −040.483333), 05.III.2013, fl., *G. Costa 815* (HUEFS, UFRN); Itagibá, Mata do Laterítico (−013.863889, −040.081667), 113.VII.2009, fl., *M.L. Guedes 16338* (ALCB); Itiruçu (−013.4411, −040.4308), I.1988, fl., *M. Sobral & L.A.M. Silva 5836* (CEPEC); Jequié, Morro da Torre (−013.5317, −040.1503), 13.IV.2007, fl., *L.P. Queiroz 12965* (HUEFS); Maracás, Fazenda do Cabloco (−013.44110, −040.43080), 27.II.2000, fl., *R.P. Oliveira 401*; Mundo Novo, Fazenda

Jequitibá, 12.V.2006, fl., *P.A. Melo 18* (HUEFS); Senhor do Bonfim, Serra da Maravilha (−010.4614, −040.1894), 28.VII.2005, fl., *R.M. Castro 1244* (HUEFS). Minas Gerais: Salto da Divisa (−016.0028, −039.9469), 31.I.2004, fl., *W.W. Thomas 13715* (CEPEC). Paraíba, Pedras de Fogo, Usina Central Olho D'água, Fazenda Livramento (−07.40194, −035.1164), 23.I.2001, fl., *I.A. Bayama 611* (MAC). Pernambuco, Jaqueira, Serra do Urubu, Mata do Jasmin (−08.6583, −035.9), 19.IX.2017, ste., *F.A.A. Nepomuceno 360* (UFP). Rio Grande do Norte, Ceará-Mirim, Fazenda Diamante (−05.583528, −035.428022), 25.V.2015, fr., *T.S. Coutinho 255* (UFP).

***Macrothumia kuhlmannii* (Sleumer) Alford**, Novon 16(3): 296. 2006.

Figures 1I, K, 3B

Trees 3.0–5.0 m tall. Branches cylindrical, glabrous to sparingly hirsute, lenticellate. Leaves alternate, leaf blade 7.0–10 x 4.0–5.0 cm, ovate, chartaceous to subcoriaceous, glabrous on both surface, base attenuate to rounded, apex acute, margin glandular-serrulate, primary vein (3), glands 2 at the base of the leaf blade, sessile, concave, glabrous, black. Inflorescences 1–2, racemiform, terminal, 3–5 flowers, peduncle 1.0–1.5 cm long, cylindrical, tomentose. Flowers with pedicel 5.0–15 mm long, cylindrical, articulate at the base, tomentose; calyx 5-merous, sepals 8.0–10 x 3.0–5.0 mm, elliptical, tomentose. Capsule not seen.

Macrothumia kuhlmannii, endemic to the Atlantic Forest to Brazil, was described as restricted to the states of Bahia, Espírito Santo, and Minas Gerais (Alford 2006). Our samples from Alagoas were collected in the understory of fragments of lowland ombrophilous forests (Fig. 3B).

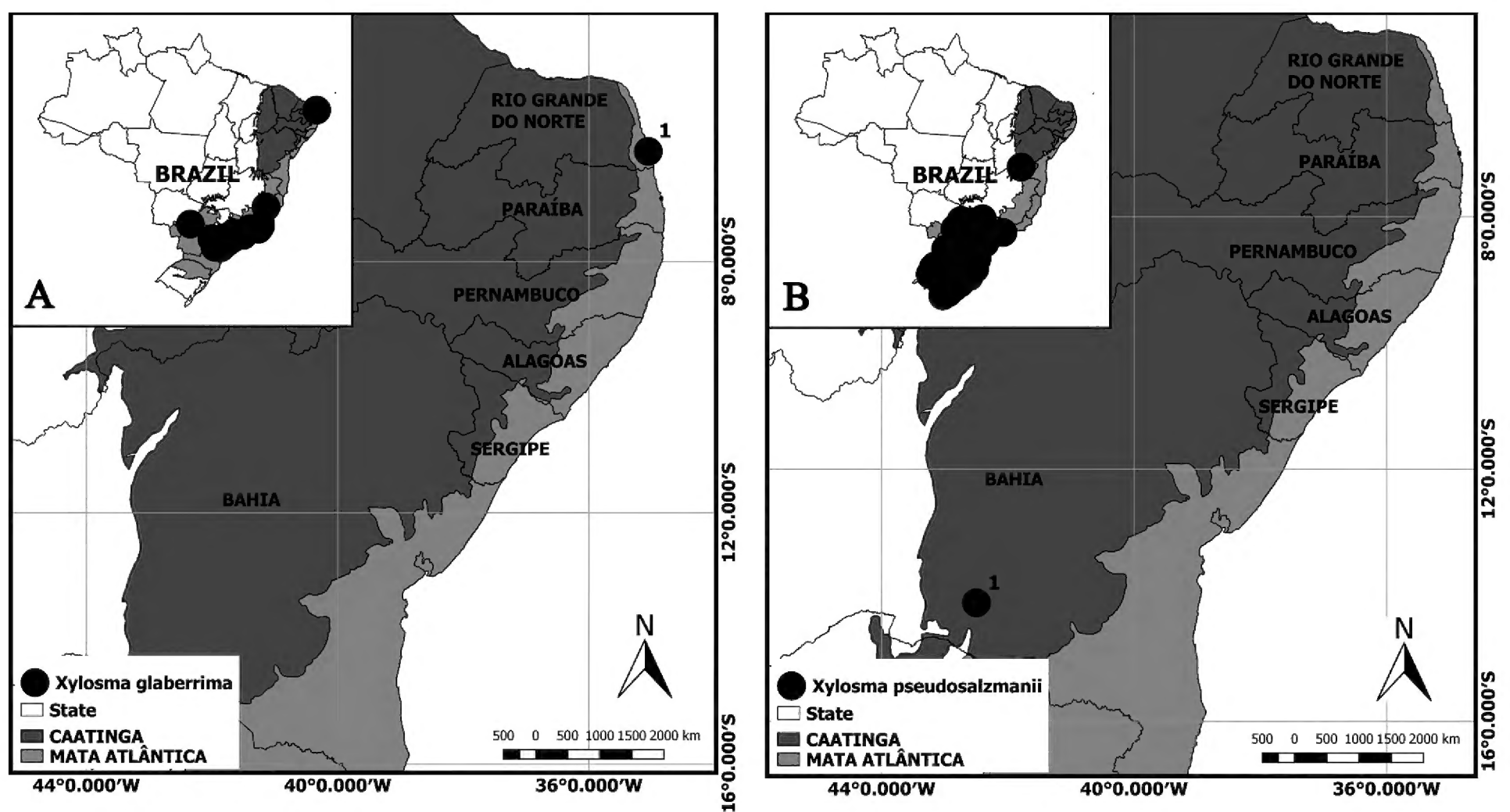


Figure 4. Geographical distribution of (A) *Xylosma glaberrima* and (B) *Xylosma pseudosalzmanii*.

Examined material. Brazil, Alagoas: São Miguel dos Campos, Mata do Beque (−09.78111, −036.0936), 03.I.1968, fl., *M.T. Monteiro 21884* (HST, HUEFS).

Xylosma glaberrima **Sleumer**, *Flora Neotropica*, Monograph 22: 175–176. 1980.

Figures 1L, O, 4A

Tree 4.0–6.0 m tall. Branches cylindrical, glabrous, lenticellate. Thorns 3.0–6.0 cm long, cylindrical. Leaves alternate, blade 9.0–12 × 3.0–4.5 cm, elliptic, chartaceous to subcoriaceous, glabrous on both surface, cuneate base, acute to short-acuminate apex, margin gland-serrated, glands 2 on the base of the leaf blade. Inflorescences 12–18(–20), fascicle, axillary, multiflorous, sessile. Male flowers with pedicels 5–6 mm long, cylindrical, articulated in the medial portion, glabrous; 5-merous, sepals 2.0–3.0 × 1.5–2.0 mm, ovate, glabrous on the surface, ciliated at the margin. Female flowers with pedicels 5.0–8.0 mm long, glabrous, cylindrical, articulated in the middle portion; 5-merous calyx, sepals 2.5–3.0 × 1.5–2.2 mm, ovate, glabrous on the surface, ciliated at the margin. Berries 5.0–10 mm in diameter, globose, glabrous, smooth in the field, rough after herborization, vinaceous to black. Seeds angular to varied shapes, glabrous, smooth, yellow, absent aryl.

Xylosma glaberrima is endemic to Brazil and was initially known from the states of Paraná, Rio de Janeiro, and São Paulo, where it occurs in dense forests and restingas of the Atlantic Forest (Sleumer 1980). Here, it is recorded from the state of Rio Grande do Norte, where it was found in forested restinga vegetation at Mata da Pipa State Park (Fig. 4A). This record reinforces the connection between the more humid southern part of the

Atlantic Forest to its much drier northern part (Barbosa 1996). In addition, we highlight the difference in altitude and rainfall between these 2 areas of Atlantic Forest (Pereira 2009). This species is morphologically similar to *X. prockia* (Turcz.) Turcz. due to the morphology of the leaf blade and apex. However, it can be distinguished by having 2 discoid glands at the base of the leaf blade (vs glands absent on the leaf blade) and flowers with glabrous pedicels (vs flowers with puberulous pedicels).

Examined material. Brazil, Rio Grande do Norte: Tibau do Sul, Parque Estadual da Mata da Pipa (−06.245833, −035.055556), 26.III.2014, fl. *J. Jardim et al. 6609* (UFRN), 26.III.2014, fl., fr., *J. Jardim et al. 6641* (UFRN).

Xylosma pseudosalzmanii **Sleumer**, *Lilloa* 26:44. 1953.

Figures 1P, Q, 4B

Shrub 2 m tall. Branches cylindrical, glabrous, rough, lenticellate. Thorns 2.0–3.0 cm long, cylindrical, glabrous. Leaves alternate, blade 6.0–8.0 × 3.0–4.0 cm, elliptic, chartaceous to subcoriaceous, glabrous on both surface, cuneate base, acuminate apex, margin gland-serrated, glands absent. Inflorescences 10–14, fascicle, axillary, multiflorous, sessile. Male flowers with pedicels 3.0–4.0 mm long, cylindrical, articulated in the base, glabrous; 5-merous, sepals 2–2.5 × 1.5–2.0 mm, ovate, glabrous, slightly pilose at the margin. Female flowers with pedicels 4.0–6.0 mm long, cylindrical, articulated in the base, glabrous; 5-merous, sepals 2.0–3.0 × 1.5–2.5 mm, ovate, glabrous, slightly pilose at the margin. Berries 6.0–8.0 mm in diameter, globose, glabrous, smooth, vinaceous. Seeds not seen.

Xylosma pseudosalzmanii was earlier reported from Argentina and Paraguay, where it occurs in gallery for-

ests, and in Brazil from the states of Paraná, Rio Grande do Sul, Santa Catarina, and São Paulo in dense forests and gallery forests (Sleumer 1980, BFG 2015). It is here recorded from the state of Bahia, in the municipality of Caetité (Fig. 4B). The new record is in Deciduous Forests, which shows that this species can live in drier habitats. Torres and Ramos (2007) considered *X. pseudosalzmanii* a synonym of *X. tweediana* (Clos) Eichler due to the overlap of vegetative characters and geographical distribution. However, both species are currently accepted (BFG 2015). *Xylosma pseudosalzmanii* has flowers with pedicels glabrous and articulated at the base, but in *X. tweediana*, they are puberulous and articulated in the middle portion.

Examined material. Brazil, Bahia: Caetité, Fazenda Baixa Grande (−014.116667, −042.5), 09.II.1997, fr., *M.L. Guedes 5277* (ALCB, CEPEC).

Discussion

The new occurrences reported here confirm that several species of Salicaceae also grow in dry areas such as in the Caatinga. This was not previously known for these taxa, which were known only from humid areas. Our results corroborate the theories proposed by Cavalcanti and Tabarelli (2004) and Maciel et al. (2017), that there is a connection between the Amazon and the Atlantic Forest through the coastal areas of the state of Ceará. The new records also confirm the co-occurrence of these species along the Atlantic Forest of the Northeastern, Southern and Southeastern Brazil, as found in other species (Barbosa 1996, Pereira 2009).

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Authors' Contributions

AN analyzed and identified the species in the herbarium and during the collection expeditions, as well as prepared the maps. MA revised the text and commented on the species.

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